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FINAL REPORT

FINAL DESIGN
ALBION-SHERIDAN TOWNSHIP LANDFILL
CALHOUN COUNTY, MI

Prepared for
Cooper Industries
Houston, Texas

and

Corning, Inc.
Corning, New York

May, 1997

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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Tables

Figures

Appendices

Woodward-Clyde Consultants (WCC) has prepared this Remedial Design Report (RDR) on behalf of Corning, Inc. and Cooper Industries (The Group) according to the Remedial Design (RD) Work Plan dated June 1996 for the Albion-Sheridan Township Landfill (ASTL) in Calhoun County, Michigan. This RDR has been completed in compliance with the proposed final remedial action presented in the Record of Decision (ROD) and the subsequent Unilateral Administrative Order (UAD) Statement of Work (SOW) issued for the site.

This Remedial Design Report contains the preliminary design for the landfill closure of the ASTL.

1.1 PURPOSE OF REMEDIAL DESIGN REPORT

The purpose of this Remedial Design Report is to provide the design for the landfill closure. The final design corresponds with 100% completion of the design. This document also describes the major components of the design approach to meet the design objectives.

1.2 ORGANIZATION OF REPORT

The PDR is divided into eleven principle sections:

- Section 1 provides an introduction, provides a site description, and summarizes previous work at ASTL.
- Section 2 provides a description of the remedial action.
- Section 3 defines the design criteria.
- Section 4 presents the design elements and analysis.
- Section 5 describes the plans and specifications.
- Section 6 presents the real estate easements and permit requirements.
- Section 7 discusses the construction schedule and contracting strategy.
- Section 8 presents the capital and operation and maintenance cost estimate
- Appendix A provides supporting documentation.
- Appendix B presents the Performance Monitoring Plan
- Appendix C presents the Draft Construction Quality Assurance Plan
- Appendix D presents the Draft Operation and Maintenance Plan

Additional supporting documentation is included in the Remedial Action Work Plan.

1.3 SITE DESCRIPTION

The information contained in Section 1.2 was derived from the Remedial Investigation (RI) Report (WW Engineering & Science, April, 1994), the ROD and SOW.

1.3.1 Location

The Albion-Sheridan Township Landfill Site is an inactive landfill located at 29975 East Erie Road approximately one mile east of Albion, Michigan on the eastern edge of Calhoun County (Figure 1). The site occupies approximately 18 acres. The site is surrounded by residential, agricultural, commercial and industrial properties. One residence is located immediately adjacent to the landfill to the south and five additional residences are located approximately 1,000 to 1,500 feet (ft) southwest of the landfill along East Erie Road. An active railroad track borders East Erie Road to the south of the landfill, and beyond the railroad tracks lies the North Branch of the Kalamazoo River. South of the river is agricultural land. The site does not fall within the flood plain of the river. There are wetlands south of the site adjacent to the river, separated from the site by the railroad tracks and Erie Road, which are not expected to be impacted by site activities.

The Amberton Village housing development is located adjacent to the site on the east side, with the closest residences approximately 500 ft from the landfill. Several residences and commercial businesses are located along Michigan Avenue approximately 500 ft north of the site. Immediately west of the site is undeveloped land formerly used for agriculture. The Orchard Knoll subdivision is located approximately 1,500 ft northwest of the landfill. Approximately 2,000 ft northwest of the site is a landfill associated with Brooks Foundry. Approximately one mile west is the City of Albion, with a population of 10,066 according to the 1990 census. This figure does not include approximately 1,700 students enrolled at Albion College located in the City of Albion.

1.3.2 History

The ASTL Site had been used as a sand and gravel borrow pit and also used for open, unpermitted dumping for an unspecified period of time prior to 1966. From 1966 to 1981, the landfill was privately owned and operated by Mr. Gordon Stevick. The landfill accepted municipal refuse and industrial wastes from households and industries in the City of Albion and nearby townships. In the early 1970s, the Michigan Department of Natural Resources (MDNR) approved the landfill to accept an estimated 6,000 cubic yards of metal plating sludges. Other materials, such as paint wastes and thinners, oil and grease, and dust, sand, and dirt containing fly ash and casting sand were also disposed of at the site. The landfill ceased operation in 1981.

1.3.3 Landfill Characteristics

The landfill is currently covered with a 1 to 4 feet thick layer of silty sand with some gravel. The cover thickness averages approximately two feet. Refuse is present within the cover material at some locations, and includes sludge, glass fragments and insulation. Refuse material is scattered at the ground surface throughout the landfill, particularly on the slopes; this material includes metal, plastic, concrete, asphalt, 55 gallon drums, wood, tires, a storage tank, and a junk crane.

The landfill ranges from 16 to 35 ft thick. During drilling of leachate head wells, refuse interlayered with medium to fine sand was encountered. Landfill gases, including total VOCs at concentrations greater than 10,000 ppm, were encountered during the installation of wells and

VICINITY MAP

NOT TO SCALE

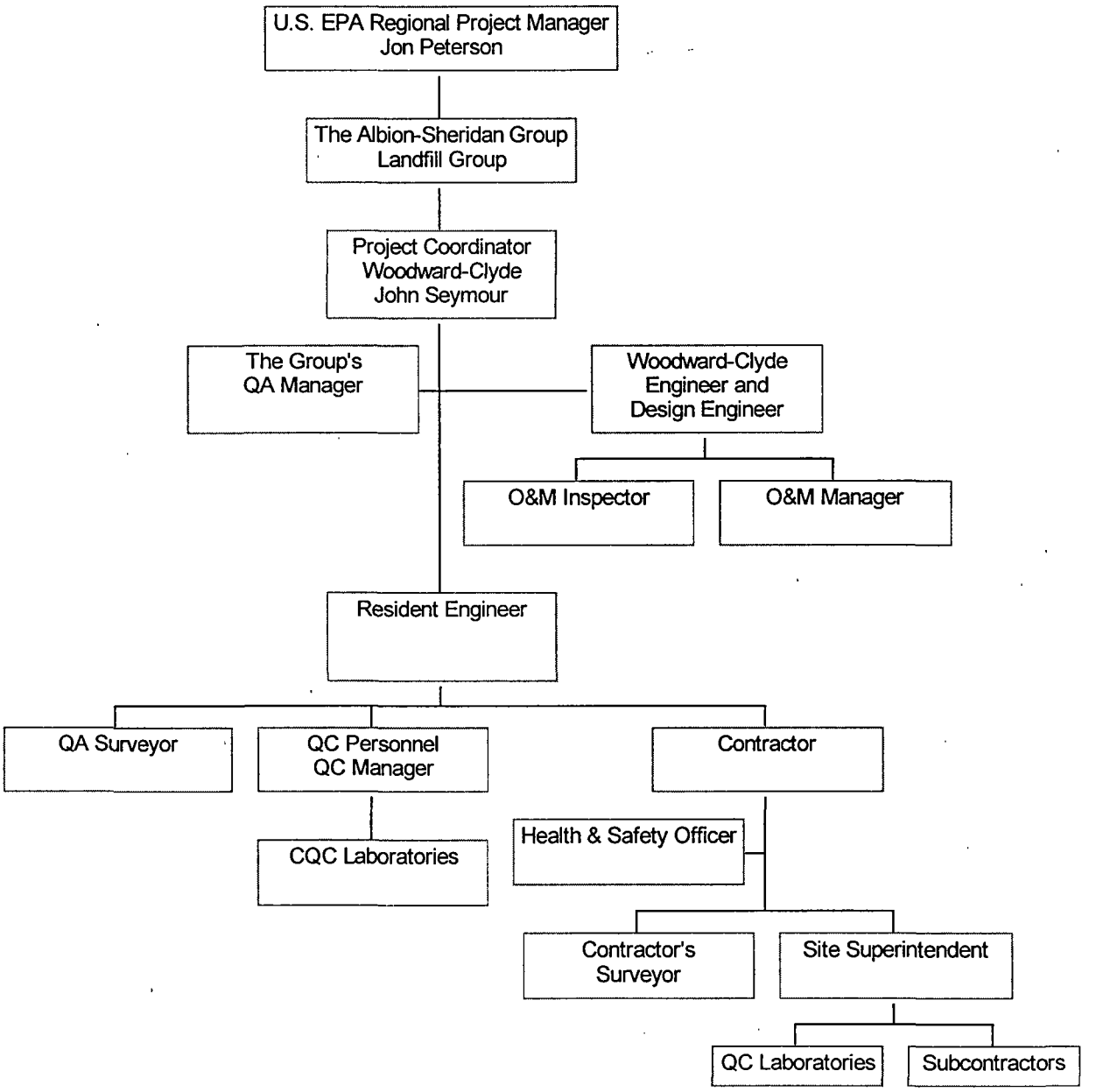
ALBION–SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

SITE LOCATION MAP

DRN BY: KAH	DATE: MAY 1997	PROJECT NO. 6E13045	FIG. NO. 1
CHK'D BY: DS	DATE: MAY 1997		

FIGURE 2
PROJECT ORGANIZATION TEAM
ALBION-SHERIDAN TOWNSHIP LANDFILL
CONSTRUCTION QUALITY ASSURANCE PLAN



subsidence monuments on the landfill. Subsurface soil/waste samples contained up to 1,500 ppm total VOCs.

1.3.4 Contaminants of Concern

Waste samples from borings contained numerous constituents, including 10 VOCs, 19 semi-volatile organic compounds (SVOCs), and 11 pesticides/PCBs. Several inorganic substances were present above background levels in subsurface soils, including antimony, arsenic, chromium, copper, lead, mercury and zinc. The highest concentrations in soil include lead at 208 mg/kg, arsenic at 13.1 mg/kg and chromium at 13.5 mg/kg. Toxicity Characteristic Leachate Procedure (TCLP) metals analysis results indicated the presence of barium and lead in the leachate, both below hazardous waste levels.

Landfill constituents in groundwater extend southwest of the landfill for approximately 900 ft and extends vertically to a depth of approximately 45 ft below the water table. The unconsolidated aquifer contains 1,2-dibromo-3-chloropropane and antimony at concentrations above their respective federal Maximum Contaminant Level (MCL). The bedrock aquifer plume contains vinyl chloride at the MCL and arsenic above the MCL, at concentrations up to 126 ug/l.

1.3.5 Geology

The geology of the site is characterized by approximately 20 to 54 ft thick glacial sediments overlying sedimentary bedrock. The glacial sediments consist of outwash sands and till, while the bedrock consists of fractured sandstone of the Marshall Formation.

Generally, the uppermost portion is composed of outwash sand from the ground surface to a depth of 10 to 30 ft below ground surface. Beneath the outwash sand is a glacial till composed primarily of silty sand with discontinuous layers containing silt and/or clay. There are no obvious clay confining layers beneath the site that are extensive enough to hydraulically isolate the landfill materials from bedrock groundwater.

The uppermost bedrock beneath the site is comprised of Mississippian-aged sandstone of the Marshall Formation. The top of the bedrock beneath the site is generally encountered at an elevation of approximately 935 to 925 feet mean sea level (MSL). The uppermost portion of the sandstone (generally the upper 5 to 25 feet) is intensely weathered. Beneath the weathered portion, the rock is more competent and better cemented; however, it is still highly fractured. The sandstone is characterized by very fine to fine-grained quartz containing trace amounts of pyrite, mica and coal.

1.3.6 Groundwater

Groundwater beneath the site is encountered within the unconsolidated and bedrock aquifers. The two units are hydraulically connected in the vicinity of the site as evidenced by water level elevations in nested monitoring wells. In addition, no significant clay layers or aquicludes were encountered during well installation drilling.

Groundwater was encountered in the unconsolidated unit throughout the site at depths of 10 to 30 ft below ground surface. Groundwater was at or very near the ground surface at the well

locations adjacent to the North Branch of the Kalamazoo River. The occurrence of shallow groundwater at the site is controlled primarily by infiltration of precipitation and the characteristics of the unconsolidated unit.

The direction of groundwater flow in the unconsolidated unit is west-southwest in the vicinity of the landfill and curves in a more southerly direction near the North Branch of the Kalamazoo River. The average hydraulic conductivity of this unit was determined during the Remedial Investigation (RI) to be 30 ft/day. The groundwater flow velocity in the unconsolidated unit was calculated to be approximately 0.30 ft/day or 100 ft/yr.

Comparing the water level data from both bedrock wells and unconsolidated wells indicates there is a vertical component to groundwater flow. The vertical component of groundwater flow is generally downward in the northern part of the site and upward south of the site near the river. The downward gradient suggests that the northern portion of the site is an area of groundwater recharge, and the upward gradient south of the site is consistent with groundwater discharging to the North Branch of the Kalamazoo River. In addition, there is an upward gradient in the MW04 well between the deep bedrock and the shallow bedrock. This indicates that the groundwater in the deep bedrock is discharging to the shallow and weathered bedrock aquifers, thus helping to protect the deeper groundwater from contamination.

1.4 SUMMARY OF PREVIOUS ACTIVITIES

In 1986, a U.S. EPA Field Investigation Team (FIT) contractor, performed a site screening inspection to score the site for the Hazard Ranking System (HRS). In 1988, U.S. EPA proposed that the site be included on the National Priority List (NPL), and in 1989, the site was officially placed on the NPL and designated a Superfund site.

During 1988 and 1989, a U.S. EPA technical team observed surface debris on the landfill, including drums which appeared to contain grease and paint waste. Some of the waste was later classified RCRA hazardous waste for toxicity and ignitability. Some waste samples contained VOCs, including ethylbenzene, toluene, tetrachloroethylene, 1,1,1-trichloroethane, and xylene.

On March 19, 1990, the U.S. EPA issued a Unilateral Administrative Order (UAO) to five potentially responsible parties (PRPs) stating that removal action was appropriate, and on May 3, 1990, the UAO was amended to delete one of the parties.

Later in 1990, two PRPs performed the removal of approximately 46 drums from the surface of the landfill. Twenty two drums were overpacked and sent to an off-site facility for incineration. The remaining 24 drums were crushed and sent to a Type 2 landfill.

In 1991, the site was selected for the presumptive remedy for CERCLA municipal landfill sites, one of the clean-up accelerating Superfund tools.

U.S. EPA initiated the RI/FS in January 1992, and the completed work reports (Final Remedial Investigation Report of the Albion-Sheridan Township Landfill, Albion, Michigan April, 1994 and the Final Presumptive Remedy Feasibility Study Report of the Albion-Sheridan Township Landfill, Albion, Michigan September, 1994) performed by WW Engineering & Science (WWES) were placed in the Administrative Record in late 1994.

U.S. EPA decided on a remedial action to be implemented at the site and executed a ROD on March 1995, on which the state has given its concurrence.

On June 6, 1995, the U.S. EPA issued special notice letters to respondents to initiate negotiations on a consent decree for performance of the Remedial Design/Remedial Action (RD/RA) for the site. Respondents declined to enter into a consent decree to conduct the RD/RA for the site in accordance with the ROD and the Statement of Work (SOW) for the site so the Agency issued an Unilateral Administrative Order (UAO) on October 11, 1995.

The Group retained WCC in March, 1996 to assist their implementing the RD/RA. WCC completed pre-design studies field work during August, 1996 and completed the Pre-Design Studies Report, Albion-Sheridan Township Landfill Calhoun County, Michigan, dated December, 1996 (PDR) which was approved by U.S. EPA on December 4, 1996. The pre-design studies consisted of installing additional groundwater monitoring wells, groundwater sampling and analyses, site surveying, further delineating the horizontal and vertical extent of waste, performing a native species revegetation study and conducting an air emissions study. The following sections briefly summarize the results of the pre-design studies.

1.4.1 Additional Monitoring Well Installation

Four ground water monitoring wells were scheduled to be installed during the pre-design studies. However, due to the inability to reach a monitoring well access agreement with the landowner (Walt Gill and Sons), two monitoring wells (MW15SB and MW 09DB) could not be installed.

Two monitoring wells (MW16SB and MW16DB) were installed during the week of August 5-12, 1996, by Environmental Drilling and Contracting, Inc. of Holland, Michigan. All drilling and well installation was supervised and documented by WCC personnel.

1.4.2 Groundwater Sampling and Analyses

Groundwater samples were collected on August 13-15, 1996 from all existing and new monitoring wells located at the site and adjacent properties as indicated in Figure 2. Verbal permission was received from Mr. Dick Gill prior to accessing his property.

Samples collected for laboratory analysis from each monitoring well were analyzed for:

- Target Compound List - Volatile Organic Compounds (TCL-VOCs)
- TCL-Semi-Volatile Organic Compounds (SVOCs)
- TCL-Pesticides/Polychlorinated biphenyls (PCBs)
- Target Analyte List (TAL)-Metals (Dissolved)
- Cyanide (Total)
- 1,2-dibromo-3-chloropropane

Field measurements of pH, specific conductance, dissolved oxygen (DO), Eh, temperature, depth of water, and groundwater elevation for all of the wells were obtained during the pre-design study and are summarized in the PDR.

Organic Analyte Analyses

MW03SG sample results revealed vinyl chloride present at the quantitation limit of 1.0 µg/L and MW07SG sample results revealed chloroethane present at the quantitation limit of 1.0 µg/L.

Bis (2-Ethylhexyl) phthalate was the only semi-volatile organic compound (SVOC) detected. It was detected in MW05SG at 6.4 µg/L which is above the 6.0 µg/L MCL. MW05SG is an upgradient monitoring well, according to documented groundwater elevations.

There were no other detections of VOC or SVOC compounds in the consolidated (bedrock) monitoring wells.

Inorganic Analyte Analyses

Inorganic analyte results from wells screened in the unconsolidated sediments are summarized as follows:

- Cadmium, cyanide and zinc were not detected.
- Arsenic was detected in 3 groundwater samples, all below the 50 µg/L MCL. Arsenic concentrations ranged from 7.9 µg/L in MW04SG to 13.2 µg/L in MW07SG.
- Calcium results ranged from 46,400 µg/L in MW08SG to 145,000 µg/L in MW03SG.
- Antimony was detected in MW01SG at 5.7 µg/L and in MW12SG at 5.6 µg/L.
- Iron was detected in 7 monitoring well samples ranging from 140 µg/L in MW12SG to 4,320 µg/L in MW03SG.
- Potassium was only detected in MW03SG and MW07SG at 22,600 µg/L (23,400 µg/L in duplicate sample) and 25,300 µg/L, respectively.
- Magnesium was detected in all monitoring well samples ranging from 11,800 µg/L in MW12SG to 53,200 µg/L in MW03SG.
- Manganese was detected in all monitoring well samples, except for MW01SG and MW08SG, in concentrations ranging from 38.1 µg/L in MW09SG to 465 µg/L in MW13SG.
- Sodium was detected in all monitoring well samples, except MW01SG, MW04SG, MW06SG and MW08SG, in concentrations ranging from 5,310 µg/L in MW09SG to 141,000 µg/L in MW03SG.
- Iron levels exceeded the 300 µg/L aesthetic drinking water value at MW03SG and MW07SG with levels of 4,320 µg/L and 4,050 µg/L, respectively.
- Manganese levels exceeded the 180 µg/L residential cleanup criteria in upgradient wells MW02SG (194 µg/L) and MW05SG (183 µg/L) and in downgradient wells MW03SG (352 µg/L), MW07SG (1,270 µg/L) and MW13SG (465 µg/L).

Inorganic analyte results from wells screened in the bedrock are summarized as follows:

- Arsenic exceeded the 50 µg/L MCL in MW06SB at a concentration of 130 µg/L. Arsenic was also detected in MW04SB (10 µg/L), MW04WB (15.8 µg/L), MW06WB (32.9 µg/L) and MW16SB (7.9 µg/L).
- Cadmium was not detected in any of the bedrock monitoring wells.
- Antimony was only detected in MW09SB at 5.2 µg/L and zinc was only detected in MW04DB at 29.6 µg/L and MW07WB at 43 µg/L.
- Calcium was detected in all bedrock monitoring well samples at concentrations ranging from 54,800 µg/L in MW08WB to 148,000 µg/L in MW03WB.
- Iron was detected in all bedrock monitoring well samples except MW04SB, MW07SB and MW09WB. Iron concentrations ranged from 186 µg/L in MW08WB to 5,330 µg/L in MW03WB.
- Potassium was detected in all bedrock monitoring well samples except MW04DB, MW07SB, MW07WB, MW08SB, MW08WB and MW16DB at concentrations ranging from 6,420 µg/L in MW05SB to 45,400 µg/L in MW04SB.
- Magnesium was detected in all bedrock monitoring well samples except, for MW07SB, at concentrations ranging from 14,500 µg/L in MW08WB to 51,700 µg/L in MW03WB.
- Maganese was detected in all bedrock monitoring well samples, except for MW07SB, at concentrations ranging from 25.4 µg/L in MW08WB to 297.0 µg/L in MW03WB.
- Sodium was detected in all bedrock monitoring well samples, except for MW08WB, at concentrations ranging from 8,310 µg/L in MW04DB to 151,000 µg/L in MW03WB.
- Iron levels exceeded the 300 µg/L aesthetic drinking water value at all bedrock monitoring wells except MW02SB, MW02WB, MW04SG, MW04SB, MW07SB, MW08WB and MW09WB.
- Manganese exceeded the 180 µg/L residential cleanup criteria in upgradient wells MW01WB (333 µg/L) and in downgradient wells MW03WB (297 µg/L), MW04SG (16,900 µg/L - 18,100 µg/L in FD-2) and MW16SB (202 µg/L).

1.4.3 Site Surveying

The accuracy of the existing topographic map (WW Engineering & Science, April, 1994) and boundary information completed during the RI was verified using standard surveying practices and existing benchmarks by a licensed surveyor, Atwell-Hicks, Inc., Ann Arbor, Michigan. The location and elevation of the two new monitoring wells and test pits were also surveyed by Atwell-Hicks, Inc.

The existing topographic information provided from the WW Engineering & Science aerial survey of the Albion-Sheridan site from 1994 was determined to have some inconsistencies when compared to the random topographic checks provided by the 1996 Atwell-Hicks pre-design survey. The random survey points generated from the ground survey indicate the topographic

information from the 1994 aerial survey on the south end of the landfill property is approximately two (2) to five (5) feet above the actual existing ground surface. Subsidence data provided in the WW Engineering & Science investigation reports and confirmed in the 1996 survey can not substantiate any large changes in elevation over this section of the landfill site. By eliminating subsidence, the conclusion reached is that the original aerial topographic survey was inaccurate. This could be attributed to a variety of factors, but most likely due to the effect trees and vegetation that mask the actual ground elevation for aerial photo interpretation.

1.4.4 Additional Horizontal and Vertical Waste Delineation

The waste fill area characterization was completed in compliance with Technical Memorandum No. 1 dated June 31, 1996. The purpose of this task was to gather further information on the vertical and horizontal extent of waste in order to analyze the design for potential footprint consolidation of the cover system. The schedule for these activities was coordinated in conjunction with the groundwater well installation/sampling and occurred on August 9-13, 1996. All work was completed in Level D personal protective equipment as the air monitoring results at test pit locations during excavation did not exceed action levels. Twenty-six test pits were completed to determine the horizontal extent of waste and eight test pits to determine the vertical extent of waste.

The horizontal edge of waste was found to generally conform to the edge of waste shown in the RI. Areas where the boundary differed were on the south and east edges of the landfill. The previous horizontal waste boundary that was outlined in the RI indicated approximately 17 acres of the site contained waste. Based on the edge of waste locations verified by this study, the waste area can be more accurately estimated at 16 acres.

Wastes encountered during the test pit excavations tended to be industrial and household waste on the major portion of the landfill. The areas north and northeast of leachate monitoring well LF-1 contained waste that consisted of large pieces of metal slag, foundry sand, and based on odor, appear to be petroleum contaminated soils.

The composition of waste observed during the vertical extent of waste investigation supported the observations made in the horizontal extent investigation as to the waste composition in the various sections of the landfill. The bottom extent of waste was located at four (4) of the eight (8) test pits that were excavated. The other test pits encountered waste deeper than the digging capabilities of the backhoe (greater than 18 feet) and further excavation was not done in these areas. No drums were found during the extent of waste investigation.

1.4.5 Native Species Revegetation Study

The purpose of this study was to evaluate the costs and practicability of revegetating the ASTL cap with native species. The study concluded that revegetating the landfill cap at ASTL with native species has substantial merit and will be implemented.

1.4.6 Air Emissions Study

The SOW for the remedial action at the ASTL establishes the requirements for performance of the remedial action. One of these requirements is the following:

At all times during the performance of the remedial action, air emissions shall not exceed a total cancer risk of 1 x 10^{-6} at the fenceline, using risk calculation methods set forth in Risk Assessment Guidance for Superfund. In addition, the air emissions shall not exceed any Applicable or Relevant and Appropriate Requirements (ARARs).

WCC used two different computer models (Landfill Air Emissions Estimation Model USEPA, 1991, Landfill Air Emissions Estimation Model, EPA-600/8-90-085a, April 1991 and Air/Superfund National Technical Guidance Study Series, Models for Estimating Air Emission Rates from Superfund Remedial Actions, USEPA 1993) to predict chemical-specific landfill gas generation rates and downwind concentrations of these chemicals to demonstrate that the total cancer risk level of 1 x 10^{-6} will not be exceeded at the fenceline from landfill remediation and waste consolidation activities.

The long-term concentrations for all nine carcinogenic compounds were compared to the MDEQ screening levels (IRSLs). The models determined that none of the chemical concentrations exceeded the screening levels and the risk level of 1 x 10^{-6} (9.30 x 10^{-7} actual) would not be exceeded for any individual compound.

The final step was to ensure that the sum of the individual risks does not exceed 1 x 10^{-6}. The unit risks were multiplied by the long-term concentrations to determine individual cancer risks. The individual risks were then added together to determine the total cancer risk at the fenceline. The total cancer risk did not exceed 1 x 10^{-6}. Therefore, the SOW requirement is expected to be complied with at all times.

Based on the results, the SOW requirements will be met by a passive gas venting system without any controls on gas emissions. It should be noted that the Landfill Air Emissions Model predicted a decreasing trend in the gas production rate starting approximately 2 years after landfill closure (1981).

1.5 SCOPE OF WORK CHECKLIST

The SOW (Page 13) details eleven items to be submitted as part of the preliminary final design. For information and review purposes the eleven items and their location in the PDR are listed below.

SOW Requirement	Report Location
Plans, drawings, and sketches, including design calculations	Sections 3-5, Drawing 10 and Appendix A
Design assumptions and parameters, including design restrictions, process performance criteria, appropriate unit processes for the treatment train, and expected removal or treatment efficiencies for both the process and waste (concentration and volume)	Sections 3-5
Proposed cleanup verification methods, including compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	Section 3
Specifications.	Appendix E
Proposed siting/locations of processes/construction activity	Section 4
Expected long-term monitoring and operation requirements	Appendix D
Real estate, easement, and permit requirements	Section 6
Preliminary construction schedule, including contracting strategy	Section 7
Final Performance Monitoring Plan	Appendix B
Final Construction Quality Assurance Plan	Appendix C
Final Contingency Plan	The contingency plan will be included in the site health and safety plan prepared by the RA Contractor.
Draft Operation and Maintenance Plan	Appendix D

2.1 PURPOSE

The purpose of remedial action at the ASTL Site is to reduce the risks associated with exposure to the contaminated materials on-site, to eliminate or reduce migration of contaminants to groundwater and to reduce the risks associated with arsenic contamination in the groundwater. The ROD describes the remedy as restrictive covenants/deed restrictions, drum removal, and the installation of a flexible membrane lined cap and gas collection system. The ROD also describes a contingent groundwater remedy if appropriate groundwater standards are not achieved..

The remedial action was selected in accordance with two threshold criteria, overall protection of human health and the environment, and compliance with the requirements of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs).

The ROD requires design and implementation of the remedial action to meet the performance standards and specifications set forth in the ROD and the SOW. The performance standards include clean-up standards, standards of control, quality criteria and other substantive requirements, criteria or limitations including all ARARs set forth in the ROD, SOW and/or UAO.

2.2 DESCRIPTION OF REMEDIAL ACTION

The remedial action is summarized below and described further in the design documents:

Site Security

A permanent fence shall be installed and maintained at the site to prevent access and vandalism to the site. The site security system of the landfill shall:

- Consist of a minimum 6 ft high fence, with a minimum three-strand barbed wire permanent chain link fence and gates around the perimeter of the landfill.
- Encompass at a minimum the landfill waste.
- Post warning signs at 200 ft intervals along the fence and at all gates.
- The permanent fence shall be completed within 30 days of the landfill cap completion. The warning signs shall:
    - Advise that area is hazardous due to chemicals in the soil which pose a risk to public health through direct contact with soils.
    - Provide a telephone number to be used for further information.

Restrictive Covenants/Deed Restriction

Future development including, but not limited to, on-site excavation, construction and drilling shall be prohibited. The prohibition is achieved by filing with the Calhoun County recorder the restrictive covenants included in Appendix E of the UAO.

Institutional controls in the form of deed restrictions or a local ordinance shall be implemented to prohibit the installation of any groundwater well which draws drinking water from the area noted in Figure 4 of the ROD to contain 2 ug/l of arsenic or more.

All restrictions regarding future development of the landfill shall be considered permanent. U.S. EPA may advise lifting the restrictions on future groundwater drinking water well installation when the arsenic concentrations in the groundwater area described in Figure 4 of the ROD remain below the MCL for two years.

Drummed Waste

Test pit area TP09 shall be excavated to uncover all drums. Solid or liquid waste drums from area TP09, nine drums previously excavated by the MDNR temporarily stored on site, and drums encountered during consolidation or site preparation determined by the drum removal contractor to be structurally sound, shall be removed to the staging area for waste characterization.

Where practical, liquid wastes from structurally unsound drums encountered at TP09 area, or during consolidation or site preparation, shall be removed and transported to the staging area for subsequent characterization.

Excavated drums showing signs of degradation shall be overpacked. The overpacked drums shall be included with the on-site overpacked drums, temporarily secured on the surface of the landfill during test pitting. Overpacked drums shall be submitted for Resource Conservation and Recovery Act (RCRA) characterization and to determine disposal options.

The ROD requires that all excavated drums containing liquid and solid wastes containing constituents in concentrations exceeding land disposal restrictions or constituents for which incineration or stabilization treatment method is prescribed to be treated or disposed off-site.

Drums containing solid wastes not banned by land disposal restrictions, may be incorporated under the ASTL cap.

Landfill Cap

The landfill cap will cover the entire landfilled waste mass as delineated in the PDR. The landfill cap will meet or exceed the substantive requirements of RCRA subtitle D (40 CFR Part 241) and any more stringent requirements of Michigan NREPA 451, 1994 Part 115 which are applicable or relevant and appropriate to the site as determined by the U.S. EPA. The multi-layer landfill cover design at a minimum will include (from the surface downward):

- Vegetative Cover: Native plant species will be used to establish a vegetative cover to control erosion.
- Topsoil Layer: The topsoil layer, which is a minimum of 6 inches (in) thick, will be placed to sustain plant growth, control erosion and promote drainage.
- Cover Soil Layer: The cover soil layer will be 18-in thick.
- Drainage Layer: The drainage layer will consist of a geonet synthetic material with a transmissivity of at least 3×10^{-5} m^2/sec.

- Flexible Membrane Liner (FML): The FML will be equivalent to or less permeable than a 40 mil low density polyethylene (LDPE), or 30 mil polyvinyl chloride (PVC).
- Gas Collection Layer: The gas collection layer will consist of a 12-in. thick sand layer on top of the existing waste mass.

The following components were identified in the SOW as parts of the construction and installation activity of the landfill cap:

- Consolidating the waste on the east edge of the landfill towards the west so that the east boundary of the landfill cap and any perimeter road needed for maintenance is contained on lot 28.
- Consolidating the waste on the south edge of the landfill so that the south boundary of the landfill cap and any perimeter road needed for maintenance is contained in lot 28, parcel 3, and parcel 2 north of a line extending to the east from the north boundary of parcel 1. If lot 28 parcels 1 and 2 are acquired, waste consolidation of the south edge will not be necessary.
- Grading the landfill to attain grades and slopes required to facilitate drainage and to meet ARARs. Regrading may be used to achieve sub-cap contours. Off-site clean fill can only be employed for grading with prior EPA approval.
- Abandoning (pull casing and seal with grout), prior to construction of cap, leachate monitoring wells LF01, LF02, and LF03.
- Closing and abandoning, prior to pre-final construction inspection, monitoring wells MW-West, MW-South and MW-East. All well abandonment and closure shall be in accordance with Michigan Act 315.
- Tree removal/conservation. Where possible, existing trees outside of the landfill cap area will be preserved.

The Group has proposed technical equivalents to the ROD and SOW requirements related to grading materials, cover system materials (drain layer) and the landfill gas system (venting wells and gas collection layer). The proposed modifications are detailed in Section 3.3.

Monitoring Program

Monitoring programs will be designed and implemented to evaluate and ensure that the remedial action complies with approved plans. The programs consist of:

- A groundwater monitoring program to detect changes in the chemical concentration of the groundwater at and adjacent to the site following completion of the remedial action.
- An air monitoring program to detect air emissions from the landfill during and after the remedial action.

Contingent Remedy

A contingent remedy may be required at a later date to address groundwater. Five years after the completion of the landfill cap, a statistical test shall be completed on data from wells where the arsenic concentration has exceeded the MCL (0.05 mg/l) at any time during the monitoring period. The SOW requires a contingency remedy be implemented if:

- The statistical test results show that arsenic concentrations will not decline below 0.05 mg/l within 15 years of landfill cap completion, and/or
- The groundwater plume affected by the landfill threatens to raise arsenic concentration in a residential well that existed on the day the ROD was signed to levels above 0.05 mg/l.
- Preparation of a work plan, conducting pilot tests, designing and installing an in-situ groundwater oxidation system capable of restoring groundwater to performance standards will be required if any of the wells fail the statistical test. The contingent remedy description and requirements are further detailed in the ROD and the SOW.

The groundwater treatment system will be included in the contingent remedy and shall consist of a network of wells designed to increase oxidation of all contaminated groundwater that exceeds the MCL for arsenic to result in arsenic precipitation from the groundwater.

Groundwater treatment shall continue in each well designated for performance monitoring until the MCL performance standard for arsenic (0.05 mg/l) is attained. If no wells fail the statistical test for arsenic concentration, and the groundwater plume does not threaten residential wells, a contingent remedy will not be required; however, groundwater monitoring shall continue for at least five years following attainment of the arsenic performance standard.

This Section presents the remediation action design criteria based on Applicable or Relevant and Appropriate Requirements (ARARs) and SOW requirements. A summary of these requirements is presented in Table 3-1. Detailed discussions of ARARs were presented in the Final Presumptive Remedy Feasibility Study Report (WW Engineering and Science, September, 1994) and the Record of Decision.

3.1 KEY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Key ARARs are summarized as action, chemical and location specific.

3.1.1 Action Specific

Resource Conservation and Recovery Act (RCRA)

RCRA Subtitle C requirements are relevant and appropriate to the portion of remedy involving off-site treatment of drummed waste with hazardous characteristics. RCRA subtitle D (40CFR Subtitle D Part 258) is appropriate to the cover system.

Michigan Environment Response Act (Act 307 and Act 451 Part 201) -- Michigan Admin Code R. 299.601 et. seq.

Act 307 requirements are relative and appropriate with respect to Type C cleanup. Type C cleanup requires long term monitoring to assess the effectiveness of on-site containment of hazardous substance.

Solid Waste Management Act (Act 641 and Act 451 Part 115) -- Michigan Code R. 299.401 et. seq.

Parts 3 and 4 requirements are relevant and appropriate to cover system, gas control and groundwater monitoring.

Clean Air Act (CAA)

New Source Performance Standards (NSPS) Title III applies if emissions from the site reach threshold limits of 10 tons per year hazardous air pollutant or 25 tons of any combination.

Michigan Air Pollution Act (Act 348) -- Michigan Admin. Code R. 336.1901 et. seq.

Act provides for fugitive dust and emissions control during and following construction.

Occupational Safety and Health Act (OSHA)

OSHA 29CFR1910 requirements are applicable to work at the site to protect the health and safety of workers.

Michigan Soil Erosion and Sedimentation Act (Act 347)

Act 347 requirements are applicable to any earth changes within 500 feet of a lake or stream.

Michigan Comp. Laws Ann. Section 257.722 ("Frost Laws")

"Frost Law" requirements are applicable to off-site activities on Michigan highways.

TABLE 3-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) SUMMARY FOR ALBION-SHERIDAN COVER DESIGN

DESIGN FEATURE	REGULATION/RULE	REQUIREMENT
Site Grading	NREPA Act 451 Michigan Air Pollution Act 348	Final Grades: - Min. 4% - Max. 25% Rule 371 requires fugitive dust control
Drum Removal	SOW	Sampling, Analysis, Transportation and Disposal Activities to meet subtitle C requirements
Site Security	SOW	Six foot chain link with three-strand barbedwire Encompass waste (as a minimum) Post warning signs at 200-foot intervals
Waste consolidation	NREPA Act 451	Placement of Waste: - in compliance with landfill operation requirements - 6 inches daily cover - compacted in 24 inch lifts.
Stormwater Management Erosion Control	NREPA Act 451 Michigan Soil Erosion and Sedimentation Act, Act 347 Rule 323.2190(a)(b)	 Control stormwater from 24 hour 25 year storm Requires a layer to protect from wind and water erosion Erosion < 2 tons/acre/year Earth Changes: - > 1 acre - 500 feet from a lake or stream Erosion Control for activities: - > 5 acres
Cover System Components	NREPA Act 451	Top Soil: - 6-inches thick - Capable of supporting vegetation

DESIGN FEATURE	REGULATION/RULE	REQUIREMENT
Cover System Components (cont.)		Common Fill/Protective Soil Layer: **- provide lateral drainage** - 24 inches thick (including topsoil) Drain Liner: - Synthetic layer with transmissivity greater that $5x10^{-5}$ m^2/sec, or - 6 inches thick sand with minimum permeability of 1 x 10^{-2} cm/sec Liner Cap - Minimum 40 mil LLDPE FML
Gas Collection and Venting System	NREPA Act 451	Gas Venting System: - 1 foot sand layer - gas risers - no lateral travel or gas accumulation
Stability Control	NREPA Act 451	Stabilize cover by appropriate: - soil type - slope - moisture content
Groundwater Monitoring and Analyses	SOW Michigan Act 641	Quarterly Monitoring Annual Monitoring Residential Well Monitoring 5 Year Review Monitoring As per SOW Requirements
General Operation and Maintenance	40 CFR 264.117(a)(1	Post Closure Care: - begins after completion of closure

3.1.2 Chemical Specific

Safe Drinking Water Act (SDWA)

SDWA requirements are relevant and appropriate to groundwater remedies at the site.

3.1.3 Location Specific

Executive Order on Flood Plain Management Exec. Order No. 11.988; 40CFR6.302(b)

Executive Order No. 11.988 requirements are applicable for those portions of the selected remedy and contingent remedy that occur in the flood plain.

Executive Order On Protection of Wetlands Exec. Order No. 11.900; 40CFR6.302(a)

Executive Order No. 11.900 requirements are applicable where portions of the selected remedy and contingent remedy have potential to impact wetlands.

Endangered Species Act 16 USC.1531 et. seq.; 50CFR Part 200, 50CFR part 802

Act requirements are not applicable. No endangered species are present on the site.

3.2 EXISTING CONDITIONS

The landfill surface has significant areas with slopes below minimum requirements for closure. The surface has poor vegetation with brush and small trees. The landfill has minimal cover material (RI indicates one to four feet) consisting of on-site silty sand with gravel soil material mixed with debris in some locations. Debris and other junk materials are scattered over the surface.

Waste extends beyond the property boundaries to the east and south and to the boundary on the west. A security fence was installed beyond the extent of waste and property line during the RI.

3.3 EVALUATION OF ALTERNATIVE MATERIALS AND DESIGN ELEMENTS

In summary, concurrence on use of the following alternative design and construction materials is requested:

1. Use of consolidated waste and on-site borrow materials for grading site to minimum slopes.
2. Use of a geonet/geotextile composite as a synthetic equivalent to the sand drain layer.
3. Use of on-site granular permeable soils with 12% or less fines and horizontal vent wells and risers to meet landfill gas control requirements.

The SOW and Feasibility Study described specific designs and materials for certain elements of the closure construction:

- Grading Materials; "Respondents may only use off-site materials for fill if those materials are approved by U.S. EPA, in consultation with MDNR, prior to use" (SOW, pg. 2, U.S. EPA, 1995)
- Cover System Materials, Drain Layer; "A 6 inch sand drainage layer or technical equivalent... The drainage layer will be composed of sand no coarser than 3/8 inch, with a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec or synthetic material with a transmissivity of at least $3x10^{-5}$ m^2/sec." (ROD, pg. 25, U.S. EPA, 1994)
- Landfill Gas System, Gas Collection Layer; "...the cap will consist of a 12 inch sand gas collection layer on top of existing waste mass ..." (ROD, pg. 25, U.S. EPA, 1994).
- Landfill Gas System, Venting Wells; "... a system of venting wells may be constructed across the landfill to vent landfill gas to the atmosphere. The gas collection or venting wells will be constructed to collect gas from the entire area and depth of the landfill." (ROD, pg. 25, U.S. EPA, 1994)

One objective of the design modifications/alternative materials is to fully utilize on-site soil materials and minimize environmental impacts to the site from the truck traffic associated with the importing of material which involve issues of road damage, congestion, dust and noise. The combination of on-site borrow sources and use of alternative designs could reduce truck traffic from an estimated 4,000 trips to the minimum traffic required for mobilization, synthetic materials and topsoil materials. This will substantially reduce environmental impacts of construction, schedule constraints imposed by truck traffic and overall project costs. The two roads most likely to be used for the transporting of this material would be Erie Road and State Route 99. Access from State Route 99 will require an easement from the property owner on the north end of the site. In addition, use of on-site materials will reduce the project schedule's dependence on winter or spring road restrictions on importation of materials. Sections 3.3.1 through 3.3.3 support the design modifications and use of alternative materials.

3.3.1 Grading Materials

The SOW states, "Respondents shall grade the landfill to attain grades and slopes required to facilitate drainage contours approved in the Remedial Design (RD). Respondents may only use off-site and to meet ARARs. Respondents may regrade the landfill as necessary to achieve sub-cap materials for fill if those materials are approved by U.S. EPA, in consultation with MDNR, prior to use." (SOW, pg. 2, U.S. EPA, 1995)

Much of the landfill surface currently does not meet minimum slopes required by MDEQ solid waste regulations. One method to achieve these grades is to import soil material to grade the landfill surface to the minimum four (4) percent slope. Preliminary calculations indicate approximately 41,000 cubic yards (in place) would have to be imported for this purpose.

Alternately, it is proposed to consolidate sufficient amounts of waste from the east perimeter of the landfill area to achieve the minimum required slopes. It is also proposed to use borrow material from or adjacent to the site to place the daily cover and gas collection/foundation layer. Waste consolidation and on-site materials will replace the imported materials significantly

reducing rough grading costs and significantly reduce truck traffic and associated environmental impacts and schedule constraints.

3.3.2 Drain Layer Materials

The ROD indicates specific design criteria/specifications for the drain layer. Materials to be used for the six (6) inch thick drainage layer shall be "a sand no coarser than 3/8-inch, with a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec, or a synthetic material with a transmissivity of at least $3x10^{-5}$ m^2/sec".

On-site soils will not meet the hydraulic conductivity criteria of $1x10^{-2}$ cm/sec. As a result, the design incorporates a synthetic drainage material. A geotextile/geonet composite component will be used consisting of a non-woven geotextile heat bonded on both sides of a HDPE geonet. This synthetic will meet the minimum transmissivity requirement of $3x10^{-5}$ m^2/sec.

3.3.3 Passive Gas Venting System

The Pre-Design Studies (WCC, 1996) determined that an active gas collection and treatment system is not required. The ROD then requires the cap to include "a 12 inch sand gas collection layer on top of existing waste mass" and "a system of venting wells constructed across the landfill to vent landfill gas to the atmosphere. The gas venting wells will be constructed to collect gas from the entire area and depth of the landfill".

Act 641, Rule 425 requires the final cover to have either of the requirements of R299.443: (a) a permeable soil layer which is not less than 1 foot thick and which is located directly below the infiltration layer that vents gas to gas risers, (b) other means of assuring that gasses cannot travel laterally from the site or accumulate in structures. Only on-site sand as defined by the United Soil Classification System with 12% or less fines will be used in this layer.

The ROD and FS describe a passive gas venting system composed of a permeable gas venting layer 12 inches thick combined with 15 vertical gas vent wells with risers. It is proposed to utilize horizontal vent wells in trenches to more effectively vent the entire area and depth of the landfill. Lateral spacing to the horizontal vent wells at 190 feet with risers every 200 feet provide over 2300 feet of pipe with atmospheric pressure to vent the landfill. Maximum travel distance for landfill gas to piping with atmospheric pressure using vertical vent wells is 141 feet while the maximum distance for horizontal vent wells is 105 feet.

3.4 DRUM REMOVAL

Steel drums located in TP-9 Area or discovered during other closure construction work will be relocated to a drum staging area. The drum staging area will be situated due south of the TP09-drum area at the southern edge of the waste consolidation area. A staging area will be constructed that is lined with an FML and bermed to contain potential spills and leaks resulting from drum handling.

The drums will be characterized to determine the appropriate disposal method. After characterization, those solid wastes found to contain organic and/or inorganic constituents in concentrations exceeding land disposal restrictions, or constituents for which incineration or

stabilization as a treatment method is prescribed, will be transported to off-site facilities for treatment. All liquid wastes will be transported to off-site facilities for treatment and/or disposal. Other non-hazardous drums will be crushed and placed in the landfill fill area. Sampling, analysis, off-site transportation and disposal will be consistent with RCRA Subtitle C requirements and EPA's Off-Site Rule. The contractor will provide a flowchart summarizing the waste characterization/disposal process as part of their drum removal and treatment monitoring plan (see Section 3 of the Performance Monitoring Plan in Appendix B).

The underground storage tanks (USTs) located on the east side of the site will be excavated and disposed of at the same time of the drum removal activities. Any liquids in the USTs will be removed and characterized along with the drum wastes. The USTs and associated piping will then be excavated, crushed and incorporated under the cap.

3.5 WASTE CONSOLIDATION AND SITE GRADING

Site Grading design criteria are:

- Minimum 4% slopes
- Maximum 25% slopes

Waste consolidation design criteria are:

- Remove all waste and visibly stained soils
- Compact consolidated waste in 2 foot lifts with trash compactor
- Apply 6 inch daily cover to consolidated waste
- Waste consolidation activities conducted under Health and Safety Plan consistent with OSHA 1910.120 requirements.

3.6 PASSIVE GAS CONTROL SYSTEM

Passive Landfill Gas Control design criteria/objectives are:

- Control lateral migration
- Prevent accumulation of landfill gas
- Collect gas from the entire area and depth of the landfill
- Comply with applicable air quality standards

3.7 COVER SYSTEM COMPONENTS

The following design criteria have been developed to meet design requirements and meet engineering practice standards.

Gas Venting/Foundation Layer

The foundation layer serves as a separation layer between the waste and the barrier layer. This permeable layer also must be vented to prevent accumulation of gas and accompanying uplift pressures to barrier layer. Design criteria for this layer are:

- Granular permeable soil materials with 12% or less fines, for gas venting
- Rounded particles no larger than 1-1/2 inch diameter, for FML foundation
- Compact to 90% of standard Proctor
- Proof roll to show absence of void spaces.

Flexible Membrane Liner

A FML barrier layer will be installed. Design criteria are use of Linear Low Density Poly Ethylene (LLDPE) geomembrane with minimum thickness of 40 mil. Textured or smooth LLDPE will be used depending on slope stability analysis. LLDPE was chosen because of its superior performance in landfill environments.

Drainage Layer

A geonet/geotextile composite will be used for the drain layer. This synthetic layer will consist of an HDPE geonet core, heat bonded on both sides with a non-woven geotextile. The drain layer will achieve a minimum transmissivity of $3x10^{-5}$ m^2/sec.

Cover Soil

Construct a layer of cover soil eighteen (18) inches thick between drain layer and vegetative top soil layer to protect the barrier layer from erosion. Design criteria for the cover soil layer are soil materials free of deleterious materials with no greater than six (6) inch particle size placed eighteen (18) inches thick over drain layer material.

Top Soil/Vegetative Layer

Construct a six (6) inch thick topsoil layer capable of sustaining vegetative growth. Topsoil design criterion are: more than 3% organic matter; silty clay loam soil with particle size less than three (3) inches; and sufficient plant nutrients to propagate and sustain vegetative growth.

The vegetative layer will be sealed with a seed mix that includes the native grass varieties as identified in the Pre-Design Studies Report (Woodward-Clyde, December 1996).

3.7.1 Stormwater and Erosion Controls

A run-on and run-off system will be installed that is capable of collecting and controlling water volume resulting from at least a 24-hour, 25-year storm event. The system shall be capable of preventing hazardous waste or its constituents from escaping into the soil, surface water bodies, groundwater, or sewer and drains.

Erosion will be limited to not more than 2 tons per acre per year.

Erosion control measures will be implemented, as necessary, to comply with the provisions of Act 347 which apply to cap construction activities.

3.8 FLOODPLAIN

No design criteria have been identified relating to floodplains since no remedial action construction activities are planned within a floodplain and hazardous wastes are not anticipated to be managed within a 100-year floodplain as designated in Figure 27 of the Final Remedial Investigation Report (WWES, 1994)

Some monitoring wells are located in the flood plain but will not affect flood plain characteristics. Should contingency action be implemented, Design Criteria will be developed to evaluate and eliminate, if appropriate, potential impacts to the flood plain.

3.9 WETLANDS

There has been no design criteria identified for wetlands as the remedial action will not impact any wetlands and there have been no wetlands identified within the remedial action area. All stormwater will be controlled on site with infiltration basins. Some wetland habitat contiguous to the North Branch of the Kalamazoo River exists. However, the remedial action will not impact this area that is across E. Erie Road. Should the contingency action be implemented, design criteria will be developed to mitigate potential impacts to nearby wetlands.

3.10 ENDANGERED SPECIES AND FAUNA

The Endangered Species Act (16 USC. 1531 et. seq. and 50 CFR Part 200 and Part 402 do not apply because no endangered or threatened species exist on the ASTL Site (Final Presumptive Remedy Feasibility Report, WWES, September, 1994).

TABLE 3-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) SUMMARY FOR ALBION-SHERIDAN COVER DESIGN

DESIGN FEATURE	REGULATION/RULE	REQUIREMENT
Site Grading	Act 451 Part 115 Michigan Air Pollution Act 348	Final Grades: - Min. 4% - Max. 25% Rule 371 requires fugitive dust control
Drum Removal	SOW	Sampling, Analysis, Transportation and Disposal Activities to meet subtitle C requirements
Site Security	SOW	Six foot chain link with three-strand barbedwire Encompass waste (as a minimum) Post warning signs at 200-foot intervals
Waste consolidation	Act 451 Part 115	Placement of Waste: - in compliance with landfill operation requirements - 6 inches daily cover - compacted in 24 inch lifts.
Stormwater Management Erosion Control	Act 451 Part 115 Michigan Soil Erosion and Sedimentation Act, Act 347 Rule 323.2190(a)(b)	 Control stormwater from 24 hour 25 year storm Requires a layer to protect from wind and water erosion Erosion < 2 tons/acre/year Earth Changes: - > 1 acre - 500 feet from a lake or stream Erosion Control for activities: - > 5 acres
Cover System Components	Act 451 Part 115	Top Soil: - 6-inches thick - Capable of supporting vegetation

DESIGN FEATURE	REGULATION/RULE	REQUIREMENT
Cover System Components (cont.)		Common Fill/Protective Soil Layer: **- provide lateral drainage** - 24 inches thick (including topsoil) Drain Liner: - Synthetic layer with transmissivity greater that $5x10^{-5}$ m^2/sec, or - 6 inches thick sand with minimum permeability of 1 x 10^{-2} cm/sec Liner Cap - Minimum 40 mil LLDPE FML
Gas Collection and Venting System	Act 451 Part 115	Gas Venting System: - 1 foot sand layer - gas risers - no lateral travel or gas accumulation
Stability Control	Act 451 Part 115	Stabilize cover by appropriate: - soil type - slope - moisture content
Groundwater Monitoring and Analyses	SOW Michigan Act 641	Quarterly Monitoring Annual Monitoring Residential Well Monitoring 5 Year Review Monitoring As per SOW Requirements
General Operation and Maintenance	40 CFR 264.117(a)(1	Post Closure Care: - begins after completion of closure

This section presents the landfill design elements related to closure of the landfill based on the applicable or relevant and appropriate requirements (ARARs) and SOW requirements outlined in the previous section. An overview of each design element will be presented to establish a basis of design and depict the characteristics of the design components. The elements to be discussed are as follows:

- Area Drum Removal and Disposal
- Waste Movement and Site Grading
- Passive Landfill Gas Control
- Landfill Cover System
- Design Analysis
- Location of Construction Activities

4.1 AREA DRUM REMOVAL AND DISPOSAL

A confirmed fill area of buried drums is located on site. This element of the project must be addressed in the cover system grading plan and be given priority in the project construction schedule.

Consideration for the drum removal and disposal has been incorporated into the design in areas such as delineating the exclusion (work) zone area for excavation, providing a staging area for drum overpacking and outlining procedures and materials to be utilized in the removal, sampling, evaluation, overpacking, transport and treatment or disposal of the drums removed.

4.2 WASTE MOVEMENT AND SITE GRADING

As it currently exists, the landfill waste disposal area is relatively flat on the main part of the fill and has steep side embankments located on a majority of the edges. Some of the waste has been placed on properties adjacent to the landfill. Trees and surface debris litter a large portion of the site.

Prior to initiating any site grading activities, all metal debris will be removed from the landfill surface and staged for salvage or incorporated under the cap. The entire site will be stripped of existing surface vegetation and debris. Cut materials, which will include some surface waste materials, will be placed within proposed fill areas on the main fill area and compacted. Trees and shrubs will be processed through a chipper prior to placement. On-site soil material will be placed on top of the stripped material on an as needed basis for a working cover to discourage any fugitive transport of waste off-site.

In order to meet the minimum slope requirements set by the Michigan Department of Environmental Quality (MDEQ) Rules (discussed in Section 3 of this report) and to support positive stormwater drainage, fill must be placed on the landfill surface and graded. Moving the waste from the eastern property boundary toward the interior of the main fill providing a 100 foot buffer for site access and stormwater drainage will also create sufficient grading material to achieve four (4) percent minimum slopes. The slopes along all sides of the landfill will be

graded to a maximum of 4 (horizontal) to 1 (vertical). A minimum of six (6) inches of soil cover material will be placed over all relocated waste upon completion of grading which will provide cover to reduce odors and discourage any transport of waste off-site.

Design grades for interior and perimeter stormwater drainage features range between 2 to 4 percent. These grades are controlled by existing site topography, outlet elevations and final landfill cover elevations.

Excavated material from proposed stormwater retention basins will be utilized for on-site soil borrow during the cover construction and coordinated with the perimeter stormwater drainage design to create retention/infiltration basins. This will eliminate any off-site discharge of the landfill stormwater runoff to surrounding roadside ditches and properties.

Final site grading will include a site access road in compliance with MDEQ Solid Waste Rules situated around the perimeter of the completed cap area. Access will also be provided to the crest of the cap for any future operations and maintenance activities. The access road will consist of a twelve (12) inch thick gravel layer twenty (20) feet wide placed on top of the cover soil layer. The perimeter road has a one (1) per cent cross grade to provide drainage from the gravel surface to the flowline and avoid ponding.

4.3 PASSIVE LANDFILL GAS CONTROL

The passive landfill gas control system for the site serves the purpose of the following items:

- Reduce gas (uplift) pressures under the FML cover system.
- Control vertical and horizontal migration of landfill gases from the landfill cover area.
- Vent gas to the atmosphere at levels which do not exceed a total cancer risk of $1x10^{-6}$ at the site fenceline.

The passive gas collection and venting system are designed based on the design analysis as discussed in Section 4.5 of this report. The horizontal passive gas vent well design includes the following components:

- Perforated High Density Polyethylene (HDPE) pipe placed within a washed stone packed trench excavated into the waste a minimum of four (4) feet.
- Vertical vent risers connected to the horizontal passive vent wells located on crest of the landfill slope spaced approximately 190 feet apart from north to south across the site.

4.4 COVER SYSTEM

The final landfill cover system contains individual components that perform a specific function in the overall performance of the landfill cover. Some of the functions considered in the design of the cover system include the following:

- Vegetative support
- Erosion control

- Drainage
- Separation
- Frost protection
- Minimizing surface water infiltration
- FML protection

Layers included in the final cover system design are outlined in the following sections and are supported by proper engineering analysis and documentation as required. The cover system components are described in the following sections from the bottom up.

4.4.1 Gas Collection/Foundation Layer

The purpose of the twelve (12) inch thick gas collection foundation layer is to provide a buffer between the waste and the flexible membrane liner (FML) to prevent any objects located on the surface of the waste that may compromise the barrier material from coming into contact with the geosynthetic material. Soil material used for the construction of this layer will be an on-site sand material consisting of rounded rock particles less than one and a half (1-1/2) inches in diameter. The material will be placed in two (2), six (6) inch lifts and completed to a density that is a minimum of 90 per cent of the standard Proctor. The final surface will be graded and rolled to produce a smooth surface that will provide a good bedding surface for the FML to provide adequate interface contact between the geosynthetic and soil.

4.4.2 Flexible Membrane Liner (FML)

Located above the foundation layer, the FML serves as the impermeable barrier to hydraulic infiltration and vertical gas migration for the cover system. The material to be used for this component is a 40 mil Linear Low Density Polyethylene (LLDPE) membrane. All seams will be overlapped and bonded together by heat fusion. Quality control testing will encompass the verification of the seams and overall quality of the material used.

Smooth surfaced FML will be used in all areas where the subgrade slope is less than 6 (horizontal) to 1 (vertical). The area of the cover system where the subgrade slope is anticipated to exceed 6 to 1 will be at the tie in of the cover system to the perimeter slopes. This area requires a textured FML to ensure slope stability on the 4 (horizontal) to 1 (vertical) slope.

4.4.3 Cover Soil

The cover soil component of the overall cover system functions in accomplishing the minimum working protection required by MDEQ and geosynthetics manufacturers. This layer will be placed directly over the drain layer and will require an on-site soil material that is similar in composition to the foundation layer.

4.4.4 Topsoil/Vegetative Layer

Six (6) inches of topsoil will form the uppermost layer of the landfill cover system. This layer's primary function is to promote and sustain vegetative growth on the surface and consequently control wind and water erosion. Proper fertilization and seeding of the 6-inch layer will yield sufficient vegetative growth that in turn will stabilize the surface of the cover system to provide long-term erosion protection. Drainage features that exceed two (2) percent slopes utilize a temporary erosion control mat that will limit erosion prior to full vegetation development. Topsoil material will be obtained from an off-site borrow source.

4.4.5 Stormwater and Erosion Controls

Stormwater from precipitation on the landfill site currently drains onto adjacent properties and infiltrates or sheet flows into highway ditches. No interior or perimeter drainage has been established on the existing landfill site.

To control and direct stormwater on the landfill cover system, three (3) foot high berms will be utilized. They require a flap of FML to be welded on the landfill impermeable membrane FML at a minimum two (2) percent grade perpendicular to the slope of the landfill. This flap is used for a back stop along the berm alignment for subsurface stormwater flow through the cover soil along the top of the impermeable FML. Perforated collection piping encompassed in a gravel pack wrapped in filter geotextile is placed up-slope from the berm flowline. Discharge of the berm and subsurface drain pipe is into the stormwater retention/infiltration basin created on the landfill property. The design for the stormwater and erosion controls for the cover system are based on the calculations outlined in Section 4.5.4 of this report.

4.5 DESIGN ANALYSIS

Supporting calculations and analysis for the design were generated for several elements of the landfill closure. Design calculations and analysis were performed in the following areas and are provided in Appendix A:

- Slope/FML stability.
- FML anchor trench depth/runout length.
- Soil loss from cover system.
- Stormwater runoff.
- Hydrologic Evaluation of Landfill Performance (HELP).
- Passive landfill gas horizontal well spacing.

4.5.1 Slope/FML Stability

The landfill cover system specified in the ROD and in this design utilizes a FML that consists of a LLDPE material placed on a layer of sand and is covered by a geonet/geotextile composite and then cover soil and topsoil. When this layered cover system is placed on a slope, the interfaces between the various material layers are subjected to shearing forces as a result of gravitational

forces that tend to pull the upper portion of the soil mass to a more nearly level surface. A stability analysis model of the design cover system on the proposed maximum landfill cover slope is necessary to ensure an adequate factor of safety against slope failure is present.

The slope stability analysis was performed for a 4 (horizontal) to 1 (vertical) slope angle and utilizing a textured FML surface. Manufacturer data for interface friction data between the geotextile surface of the overlying drainage net and the textured FML was used. The underlying gas collection/foundation layer used a interface friction angle with the FML similar to that of an Ottawa Sand (clean, medium grained sand). Both sets of data used for this key interface area are believed to be conservative. The soil layers above the FML have been modeled as unsaturated for this analysis based on the results of the HELP model results for a 25 year, 24 hour design storm. Saturated conditions for the soil and waste under the FML were assumed, but because of an assumed static level of moisture in these layers the seepage component was not calculated.

Results of the analysis indicate satisfactory factors of safety against slope failure. The range of these factors was between 1.7 and 2.3. A factor of safety of 1.0 or less would merit a re-design of the landfill cover system and/or slope configurations.

4.5.2 FML Anchor Trench Depth/Runout Length

Geomembrane (FML) covered landfill caps require the use of an anchor trench on the edges of the capped area to keep the geosynthetic in place. Tensile forces due to uplift from landfill gas pressures or from surcharge loading on the cover system are the components that cause the anchor trench to be a requirement in geosynthetic cover systems.

The anchor trench consists of an excavation that is made around the perimeter of the covered waste area to the required depth, laying the FML over the side and bottom of the trench and then backfilling soil over the FML to hold the material in place. The required depth of the trench is determined by considering all the forces and associated stresses that act upon the FML. A factor of safety is applied to the maximum tensile force the geosynthetic material can resist to provide accommodation for worst-case scenarios.

Utilizing a conservative factor of safety of 4.0, the results for the required anchor trench depth and runout length indicate the depth to be approximately 1.9 feet and the width to be 2.0 feet. This information will be reflected in the design drawings by the incorporation of an anchor trench configuration that is 2 feet deep by 2 feet wide.

4.5.3 Soil Loss From Cover System

To predict the performance of the designed cover system configuration and the landfill cap slopes, the soil loss due to erosion was modeled. This analysis estimates the amount of soil erosion by precipitation and stormwater runoff. The maximum allowed soil loss due to erosion is two (2) tons per acre of landfill surface.

The analysis completed for the soil loss performance of the landfill cover system included some assumptions as the exact soil types to be used for the cover system and final grading plan have not yet been determined. This led to conservative material and slope configurations that are reflected in the calculation provided in Appendix A. Ground cover conditions analyzed for the

site included 80 percent and 95-100 percent surface cover scenarios; these cover scenarios are most applicable to post-construction and long term landfill cap conditions, respectively.

Results indicate the assumed worst case soil and slope configuration used for the analysis show the soil loss for the 80 percent ground cover and 95-100 percent ground cover conditions are less than the allowed maximum of two (2) tons acre/year.

4.5.4 Stormwater Runoff

Stormwater runoff for the project site has been designed to exceed requirements outlined in the MDEQ Act 641 Rules. Guidelines provided in the Rules, indicate the landfill cap stormwater drainage and site retention/infiltration basins must perform adequately to the 24 hour 25 year design storm event. The design storm used for the evaluation of the site utilized the 24 hour 100 year storm event to provide additional capacity to the diversion structures and retention/infiltration basins.

The final site grading plan and stormwater management plan were divided into subwatershed areas that were determined based on landfill slope directions, locations of stormwater berms, and flow directions of the berms. Four subwatersheds were derived in this process.

Eagle Point watershed analysis software was next utilized and it incorporated the Soil Conservation Service TR-55 model for generation of the unit hydrographs. A triangular unit hydrograph distribution was produced using a curve number (CN) of 74. This CN corresponds with a clay loam soil (topsoil) and a vegetative cover in good condition (75% grass cover or more). These unit hydrographs were then used to generate computed flood hydrographs for the respective subwatersheds and produced a volume of stormwater discharge based on the 24 hour 100 year storm event precipitation of 5.78 inches.

Results of the analysis indicate a total required storage for the project site for the modeled storm event of approximately five (5) acre-feet. The eastern basin for the site will receive stormwater from two of the subwatershed areas that will require a total of 2.8 acre-feet of retention for the modeled storm. Available retention (with 2 feet of freeboard) is approximately 6 acre-feet. The western basin has been sized in conjunction with the soil borrow needed for the landfill cap materials and will easily handle the 1.0 acre-feet required by one subwatershed draining into it. The runoff from the western sub-watershed will be sheet flow of the landfill cap.

4.5.5 Hydrologic Evaluation of Landfill Performance (HELP)

A computer-based analysis (Appendix A) was performed to predict the infiltration performance of the landfill cover system by taking into consideration the soil/material used in each layer. Meteorological data that is specific to the region of the site is synthetically fabricated by the HELP program for the number of years specified creating a well-rounded model that accounts for most elements of cover system hydrologic performance.

A twenty-five (25) year storm event was analyzed for the design cover system. FML pinhole densities and FML installation defects were assumed to be relative to good installation quality. It was believed that with proper site construction QA/QC with experienced inspection personnel that this quality could be easily achieved.

The HELP analysis for both precipitation events indicated no percolation/leakage through the FML layer. Average water head across the FML layer (based on peak daily values) shows less than one (1) inch of accumulation.

4.5.6 Passive Landfill Gas Horizontal Well Spacing

Calculations (Appendix A) were performed to model the flow length required to effectively collect and vent the landfill gas produced under the final cover system. The analysis was based on proven corrective gas flow mechanisms and Darcy's equation assuming laminar flow. Typical landfill parameters cited in several literature sources were substituted in the analysis as site specific information was not available in the previous investigative studies performed for the site. The flow length equation derived from Darcy's equation utilized the following input parameters:

- Refuse permeability.
- Depth ratio (saturated gas flow depth versus depth of refuse).
- Specific weight of landfill gas.
- Landfill gas production rate.
- Landfill gas pressure.
- Refuse density.
- Atmospheric pressure.

Results of the analysis provided a flow length of approximately 95 feet. Because landfill gas will flow to a horizontal vent well from both directions within the interior of the landfill, the spacing of the vent wells will be twice the gas flow length. This provides a spacing guideline for the horizontal vent wells in the interior of the landfill of 190 feet.

4.6 LOCATION OF CONSTRUCTION ACTIVITIES

Various areas of the site and adjacent properties will be utilized during the construction phase of the project. These areas must be considered during the design process with respect to preservation of completed areas and areas sensitive to equipment traffic after completion of a designed closure component. The areas that will be addressed in this section include three major areas of the landfill construction as follows:

- Contractor staging/material storage
- Landfill closure activities
- Material borrow sources

4.6.1 Contractor Staging/Material Storage

The contractor selected for the construction phase of the project will require mobilization of equipment and materials to the site for the landfill closure. An area is needed to store equipment and materials as well as provide an area for employee parking and field offices. The area that is

to be used in this capacity is the south end of the site bordering Erie Road. This will allow for easy transport and drop off of materials and equipment to the site and provide easy access to the cap areas where the equipment and materials will be used. If needed, additional staging area on the north side of the site may be used. This would encompass the proposed material borrow area/stormwater infiltration basin.

4.6.2 Landfill Closure Activities

The landfill construction activities will encompass the entire 18 acre site from the initiation of the remedial action. This will begin with the stripping and grubbing of the landfill area and continue with waste relocation efforts, passive gas system installation, followed by cover system placement and establishment of all access and stormwater controls. Based on the site design, these activities are able to be coordinated to ensure an efficient and quality closure.

4.6.3 Material Borrow Sources

The design indicates one soil material borrow source for the site that will be utilized for construction of the landfill cover system. Excavation activities will be located on the northern section of the landfill property and can also be considered as part of the stormwater control system construction. Depending on the soil quantities needed for the final cover system and the amount available on the north end (as determined in the final design), borrow activities could carry over to the south end of the landfill along Erie Road.

5.1 DESIGN DRAWINGS

Design drawings for the remedial action outline several components of the project. The following is a list of drawings that have been developed for the preliminary design submittal:

Drawing Number	Drawing Description
1	Location Maps and Drawing Index
2	Existing Site Conditions
3	Grading Plan
4	Cover System Sections and Details
5	Stormwater Control Plan
6	Stormwater Control Sections and Details
7	Passive Landfill Gas Control Plan
8	Passive Landfill Gas Control Sections and Details
9	Perimeter Fence and Access Road Plan and Details
10	Erosion Control Plan and Details

The drawings listed above are attached to this report in Appendix E. Sheets 9-11 are reserved for further development of the design. Sections and details of the cover system and finished grade necessary for construction are detailed on these sheets.

5.2 TECHNICAL SPECIFICATIONS

Specifications (Appendix E) are required for the various landfill components of the remedial action implementation. The purpose of the specifications is to provide requirements to the contractor on quality, type and performance issues associated with the various contents of the work. The following is a list of sections to be included in the specifications developed for the final design of the project:

Specification Section	Description
01011	Summary of Project
01039	Progress Meetings
01052	Pollution Control
01300	Submittals
01450	Health and Safety
01500	Mobilization and Temporary Controls
02110	Clearing, Stripping and Grubbing
02115	Site Preparation
02211	Waste Excavation and Handling
02220	Earthwork
02235	Filter Fabric
02240	Drainage Net
02715	HDPE Pipe
002778	Geomembrane
02831	Chain Link Fence and Gates
02936	Seeding

This section identifies the properties related to the Remedial Action, any deed restrictions that will be imposed on the properties following completion of construction, easements that will be needed for construction and environmental monitoring, and applicable state, county and local permits required.

6.1 INTRODUCTION

Future development including, but not limited to, on-site excavation, construction and drilling shall be prohibited. The prohibition is achieved by filing with the Calhoun County recorder the restrictive covenants included in Appendix E of the UAO.

6.2 DEED RESTRICTIONS

Institutional controls in the form of deed restrictions or a local ordinance shall be implemented. The deed restrictions will prohibit the installation of any groundwater well which draws drinking water from the area noted in Figure 4 of the ROD to contain 2 ug/l of arsenic or more.

All restrictions regarding future development of the landfill shall be considered permanent. U.S. EPA may advise lifting the restrictions on future groundwater drinking water well installation when the arsenic concentrations in the groundwater area described in Figure 4 of the ROD remain below the MCL for two years.

6.3 EASEMENTS

Easements for access to properties adjacent to the landfill property for the construction and post-closure monitoring phases will be needed. Reasons for the establishment of these easements is outlined in the following sections.

6.3.1 Environmental Monitoring

Groundwater monitoring wells are currently in place on properties surrounding the landfill site. Access to these wells for post-closure monitoring will require adequate access for sampling for all properties involved.

6.3.2 Construction

During the construction phase of the project, access will be needed to adjacent properties for a few reasons. One aspect involves the waste relocation from properties on the east side of the site. Foliage and soil will be removed in this process and slopes will need to be reconstructed.

The other aspect involves site construction equipment and material storage areas. This requirement will have to infringe on the current property boundaries as the landfill proper will be encompassed in waste relocation and grading activities for a majority of the construction period rendering it impossible for storage of equipment and materials on the site. There also will need to be space designated in this lay-down area for office trailers for the contractor, subcontractors and the site engineer. This activity may require the vegetation be removed and the ground surface graded level if needed.

6.4 PERMIT REQUIREMENTS

WCC contacted personnel at Calhoun County and MDEQ (air quality and surface water division) to establish specific local requirements for the construction of the project. The City of Albion was not contacted as the project location is outside city limits.

Calhoun County personnel indicated they would require a Erosion Control Permit for any project that would involve the disturbance of more than 1 acre of land or was conducted within 500 feet of a waterway. This permit would require the submission of an application with the final project plans attached for review by the county. The application will be completed by the contractor prior to the start of construction and the contractor will be held responsible for compliance with the permit conditions.

The air quality division of the MDEQ has several rules under Act 451 of 1994 that should be considered. Primarily, Rule 230 concerning Air Toxics from New and Modified Sources, would have to be met. The rule provides atmospheric discharge limits that must not be exceeded. These limits are based upon the same risk level as required by the SOW; therefore, the MDEQ concerns will be addressed if the SOW requirements are met.

7.1 CONTRACTING STRATEGY

The Group has taken a traditional (bid-build) construction contracting strategy into consideration at this time. This strategy will require approximately 60 days to complete contractor selection as the process involves the following tasks:

- Preparation of bid document.
- Client review.
- Revisions to bid document.
- Solicitation of construction bids.
- Contractor selection.
- Negotiation of construction contract.

After these items are addressed, a notice to proceed will be issued to the selected contractor and implementation of the Remedial Action will begin.

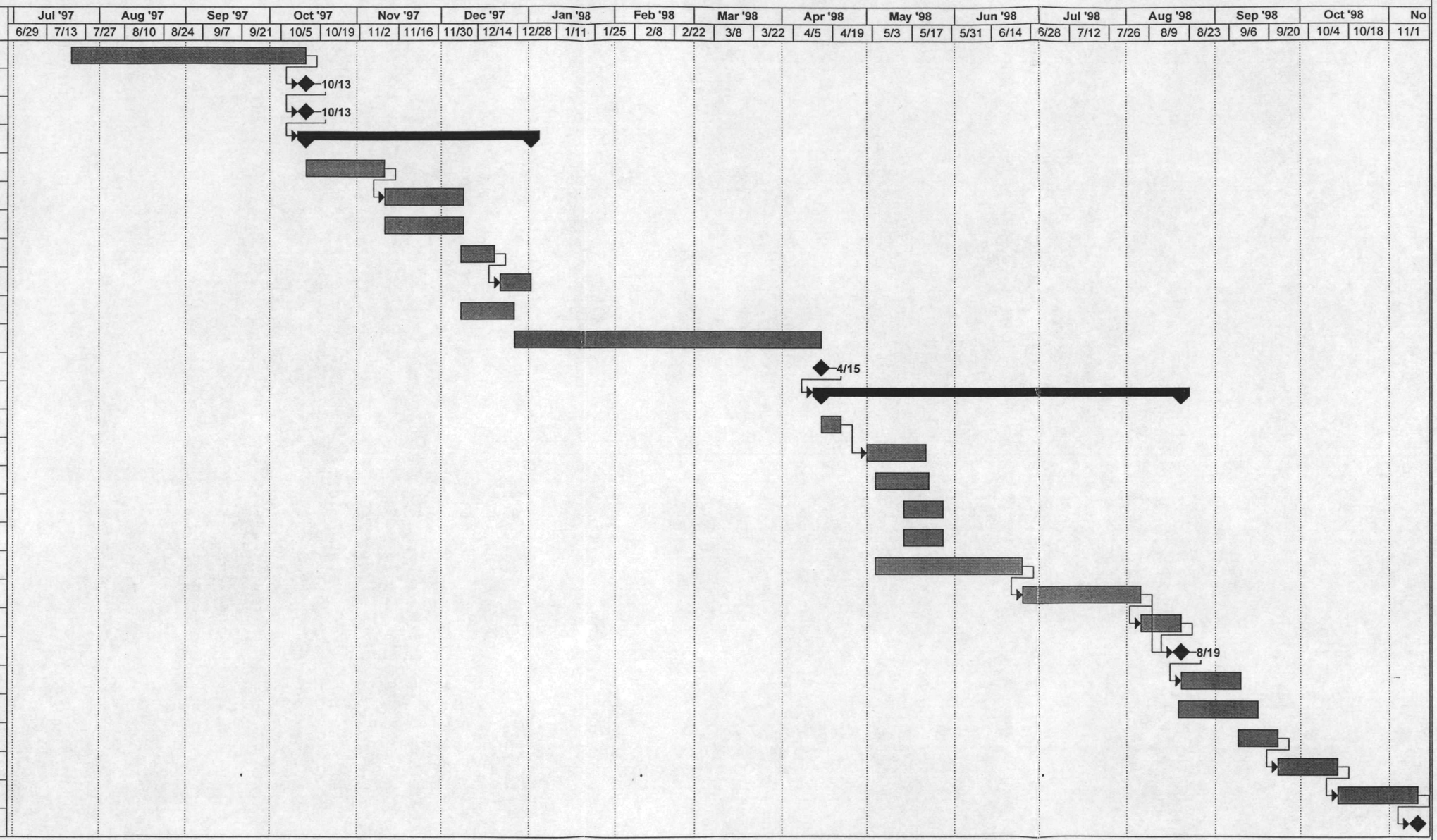
7.2 CONSTRUCTION SCHEDULE

A project schedule for the Remedial Action is submitted as Figure 7-1 which outlines the anticipated construction schedule. This schedule reflects the major components of the construction for the site and the milestones as outlined in the SOW. The schedule represents the scenario for the construction with the bid-build contracting strategy.

The selected Contractor will be required to submit a final construction schedule within 5 days of receiving the Notice to Proceed.

FIGURE 7-1
CONSTRUCTION SCHEDULE
ALBION-SHERIDAN TOWNSHIP LANDFILL

ID	Task Name
1	**Remedial Action Contracting**
2	Notice to Proceed
3	1997 Construction Start
4	**1997 Remedial Action Construction**
5	Mobilization
6	Drum Removal
7	Stripping and Grubbing
8	Waste Removal/Grading
9	Passive Gas Vent Trenches
10	Foundation Layer
11	Winter Shutdown
12	1998 Construction Start
13	**1998 Remedial Action Construction**
14	Regrading
15	FML/Drainage Net
16	Cover Soil Layer
17	Subsurface Drainage
18	Berm/Cap Access Road
19	Borrow/Infiltration
20	Topsoil/Seeding
21	Perimeter Fence
22	**Preliminary Construction Completion**
23	Pre-Final Inspection
24	Final O&M Plan
25	Pre-Final Inspection Report
26	Final Inspection
27	Final Construction Report
28	**Completion**



Project: Albion-Sheridan Landfill

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

***NOTE: FINAL SCHEDULE WILL BE SUBMITTED BY THE SELECTED CONTRACTOR.

CONCLUSIONS TO DATE FROM DESIGN CRITERIA TASKS

1. The overfill from the construction of the box trench will have to be excavated and properly disposed in order to excavate the west side of the Lagoon. The amount of material to be disposed by rail and/or truck will increase approximately 3000 yards.

2. The demarcation between the sediment and the Cahokia unit is not as clearly defined as expected. The initial field excavation indicates a thick layer of blue/gray material is the initiating layer in the Cahokia unit. This will require an estimated 1 foot undercut excavation in order to assure the removal of the contaminated sediments. This 1 foot undercut will increase the amount of material to be disposed and the amount of backfill required.

3. The amount of more heavily contaminated material is proportionally larger than indicated by prior sampling. Specifically, the sampling results indicate that ~~60~~ 70 percent may be classified as RCRA/TSCA waste, 20 percent TSCA waste and 10 percent RCRA waste.

4. The field effort to date indicates that the excavation activity will be restricted significantly by the time required for dewatering of the sediments. The effort, to date, indicates that without this preliminary excavation and dewatering program, it would be impossible for an excavation contractor to meet the original schedule. The ongoing test excavation and dewatering activity is expected to yield the necessary methodology for inclusion in the excavation specification. The excavation specification will have to allow the excavation contractor the ability to quote cost reimbursable terms because of the scope for such crucial items as variances in dewatering time and changes to the sequence of excavation cannot be defined.

5. Preliminary discussion with the transportation and disposal contractors indicate that only one contractor may offer train shipment; others will propose use of trucks. The excavation specification will, as a result, require the excavation contractor to quote the loading of trucks and rail cars in order to accommodate the variety of disposal contractors. In addition, the excavation contractor will be required to work flexible schedules to accommodate the truck/train availability, and the increased amount of material.

6. The scope of the excavation specification presently includes the excavation, placement of material for dewatering, loading of rail cars/trucks and backfilling. If Perland continues the tests, excavation, and dewatering activity at the planned excavation rate, 1,000 cubic yards per day, the selected excavation contractor's effort will be restricted to loading the trains and completing the backfill activity.